



**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

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TC 1700

In re Appln. of: NAGAKURA

Serial No.: 09/819,516

Filed: March 27, 2001

For: AIR-TIGHT VESSEL EQUIPPED WITH GAS FEEDER ...

Group: 1763

Examiner: KARLA A. MOORE

Docket: NEC N00-1101

MAIL STOP APPEAL BRIEF - PATENTS

Commissioner for Patents

P.O. Box 1450

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**APPELLANT'S BRIEF ON APPEAL**

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**APPELLANT'S BRIEF ON APPEAL**

This Brief is being filed in support of Appellant's Appeal from the Final Rejection by the Examiner, the Notice of which was timely filed on April 3, 2003.

**REAL PARTY IN INTEREST**

The Real Party in Interest in this Application is NEC Electronics Corporation, which has a place of business at 1753 Shimonumabe, Nakahara-ku, Kawasaki, Kanagawa, JAPAN 211-8668. NEC Electronics Corporation received an Assignment of all right, title and interest in the Application through an Assignment executed by NEC Corporation on November 1, 2002. The Assignment to NEC Electronics Corporation was submitted to the U.S. Patent and Trademark Office for recordation on February 11, 2003. NEC Corporation, which has a place of business at 7-1, Shiba 5-chome, Minato-ku, Tokyo, JAPAN received an Assignment of all right, title and interest in the Application through an Assignment executed by the inventor, Yutaka Nagakura, on March 15, 2001 and by virtue of his employment by NEC Corporation. The Assignment to

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NEC Corporation was recorded in the U.S. Patent and Trademark Office at Reel 011660,  
Frame 0436.

### RELATED APPEALS AND INTERFERENCES

To the best of the knowledge and the belief of the undersigned attorney and the Appellant, no appeals or interferences exist that would directly affect, or be directly affected by, or have a bearing on the Board's decision in the instant Appeal.

### STATUS OF THE CLAIMS ON APPEAL

Claims 1-19 are pending in the current Application. All the pending claims (claims 1-19) stand finally rejected, and are on Appeal. The claims on Appeal are set forth in **Appendix A** attached hereto.

### STATUS OF THE AMENDMENTS

Appellant filed Amendment B under Rule 116, containing no claim changes, which Amendment B under Rule 116 was entered by the Examiner in the Advisory Action mailed March 20, 2003. Claims 1 and 13 were amended in Amendment A, and are set forth, as amended, in **Appendix A**.

### BACKGROUND OF THE INVENTION

The invention on Appeal relates to a gas treatment system used in the semiconductor manufacturing field.

Vertical low-pressure chemical vapor deposition systems are widely used in the semiconductor industry. Such systems typically comprise a closed chamber in which a plurality of semiconductor wafers are supported vertically at spaced intervals. Gaseous mixtures

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containing doping gases and vapor phase growing gases are introduced into the chamber via a vertical gas feeder tube. One form of conventional vertical gas feeder tube is shown in Fig. 2 of the instant Application, reproduced below for the convenience of the Board, and comprises an elongate hollow tube, closed at one end, and having a plurality of equal sized and spaced gas outlet holes.

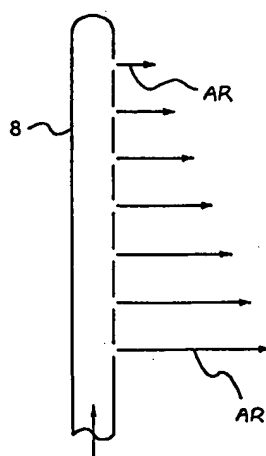


Fig. 2  
PRIOR ART

A technical problem with prior art reactor containing a gas feeder such as shown in PRIOR ART Fig. 2 is that since the gas outlet holes are equal in diameter spaced equally along the length of the tube, a pressure gradient results inside the gas feeder, as indicated by arrows AR. The higher the gas pressure, the higher the flow rate. As a result, the concentration of reactant gas varies along the distance from the lower end of the gas feeder to the top end, and therefore from the lower end of the reactor to the top end. As a result, deposition thicknesses vary.

In order to achieve better uniformity of thickness, dummy wafers are placed at both ends of the wafer boat. However, this results in reduction in furnace throughput. Thus, there is a trade-off between throughput and uniformity.

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One proposed solution to the problem of uniformity is shown in PRIOR ART Fig. 3 of the instant Application, reduced below for the convenience of the Board.

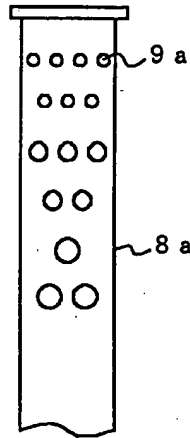


Fig. 3  
PRIOR ART

In accordance with Fig. 3, a gas feeder tube is provided with a plurality of outlet holes of varying diameter and number. The PRIOR ART Fig. 3, the outlet hole diameter is decreased from the inlet end of the gas feeder to the closed distal end, while the density of gas outlet holes are increased towards the distal end. While the PRIOR ART Fig. 3 gas feeder tube overcomes the problems of varying gas flow rate as above discussed, the small gas outlet holes formed adjacent the distal end of the gas feeder tube are prone to clogging. Thus, periodic cleaning is required, which reduces furnace throughput. Also, the large diameter holes adjacent the inlet end of the gas feeder tube seriously reduce the strength of the tube rendering the tube breakable.

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### THE INVENTION ON APPEAL

The present invention provides a gas treatment apparatus having a unique gas feeder which overcomes the aforesaid and other technical problems of the prior art. More particularly, in accordance with the present invention, a gas feeder 8B is provided inside the inner tube 3, and is disposed between the inner tube 3 and the wafer boat 5. The gas feeder 8B has a configuration like a part of a cone, and is open to the wafer boat 5. The distance from the wafer boat 5 is constant, as shown in Fig. 4 below:

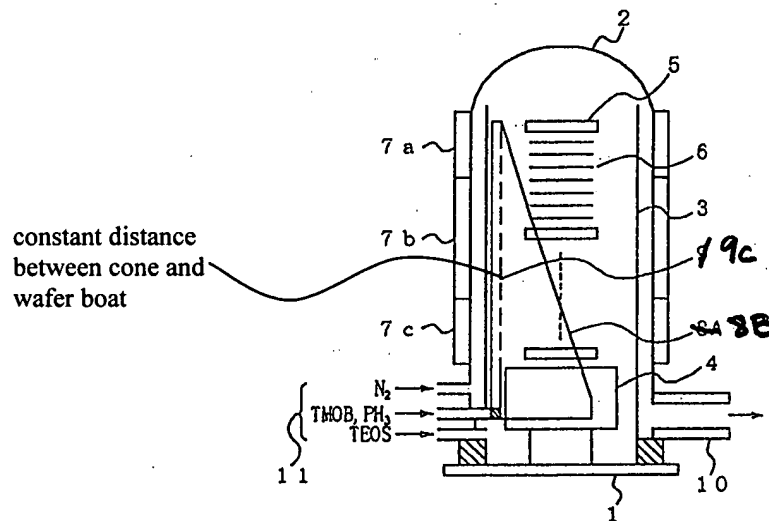


Fig. 4

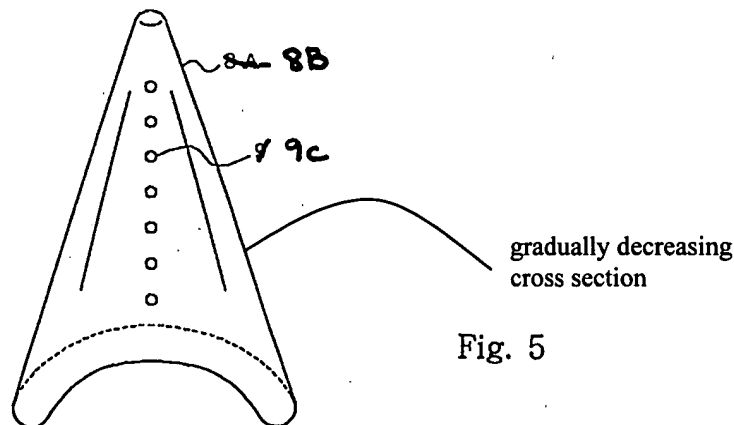


Fig. 5

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As seen in Fig. 5 above, since the cross section of the gas feeder 8B is gradually decreased, the gas feeder 8B keeps the gas pressure constant regardless of the distance from the gas inlet port. In other words, the gas pressure is equalized between the zone around the gas inlet port and the zone around the lip of the gas feeder. As a result, gas pressure around the wafers is uniform, and deposition is uniform.

### ISSUES PRESENTED ON APPEAL

1. Whether claims 1-12 are unpatentable under 35 USC §103 as obvious over Hattori (U.S. Patent No. 5,164,012) in view of Gengler (U.S. Patent No. 5,505,385).
2. Whether claims 13-19 are unpatentable under 35 USC §103 as obvious over Hattori and Gengler in further view of Hwang (U.S. Patent No. 5,441,570).

### THE FINAL ACTION

In finally rejecting the claims on Appeal, the Examiner states the following:

2. Claims 1-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,164,012 to Hattori in view of U.S. Patent No. 5,505,385 to Gengler.

\* \* \*

4. Hattori discloses a gas treatment apparatus in Figure 1, comprising: an outer tube (11) having a gas inlet port (lower entrance portion of 17) connected to a gas supply system for receiving gas and a gas outlet port (21) connected to an exhaust pipe (20) and serving as a shell of a reactor forming a part of a chemical vapor deposition system, and defining an inner space; a wafer boat (15) provided in said inner space and holding plural wafers (14) spaced from one another in a predetermined direction; an inner tube (10) provided between said wafer boat and said outer tube and elongated in said predetermined direction; and a gas feeder (upper portion of 17 extending along the length of the apparatus) provided between said inner tube and said wafer boat, connected to said gas inlet port and defining a gas passage formed with a plurality of like gas outlet holes (19) equal in open area and equally spaced in said predetermined

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direction for blowing said gas to said wafers. In Figure 3, Hattori discloses a gas feeder (25) configuration with a convex outer surface and a concave inner surface and semi-cylindrical (i.e. generally crescent-shaped) side surfaces connected between side lines of said concave inner surface and side lines of said concave inner surface.

Detailed Action, p. 2.

8. ...Hattori fails to disclose a gas passage gradually reduced in area, in which said gas feeder has a narrow end surface and wide end surface.

9. Gengler teach [sic] tapering a flow device from a larger diameter at its open end to a smaller diameter at its other end to thereby assist in equalizing the pressure and the flow of gas along the extending length of the device ... .

10. It would have been obvious to one of ordinary skill in the art at the time the Applicant's invention was made to have provided a gas passage reduced in area, in which said gas feeder has a narrow end surface and a wide end surface in Hattori in order to equalize gas flow along the length of a device as taught by Gengler.

\* \* \*

13. Claims 13-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hattori and Gengler as applied to claims 1-12 above, and further in view of U.S. Patent No. 5,441,570 to Hwang et al.

\* \* \*

15. ... Hattori and Gengler fail to teach the apparatus as an air-tight vessel.

Detailed Action, p. 3

16. Hwang et al. teach supplying and maintaining a vacuum, which necessarily implies the vessel is airtight, in a LPCVD process in order to deposit compound source gases on wafers (column 1, rows 20-24 and column 2, rows 25-31).

17. It would have been obvious to one of ordinary skill in the art at the time the Applicant's invention was made to have provided an air-tight

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vessel in the prior art in order to deposit compound source gases on wafer using an LPCVD process as taught by Hwang.

Detailed Action, p. 4

### GROUPING OF CLAIMS

Claims 1-12 are grouped together as containing the same essential patentable limitations.

These claims stand or fall together.

Claims 13-19 are grouped together as containing the same essential patentable limitations. Thus, these claims stand or fall together.

As noted *supra*, the claims on Appeal are set forth in **Appendix A** attached hereto.

### THE REFERENCES

#### Gengler, U.S. Patent No. 5,505,385 ("Gengler")

As set forth at col. 1, line 50 to col. 2, line 20, Gengler describes an air diffuser for distributing conditioned air to air jet spinning machines and the like that includes a tubular outer member formed with openings therein and a tubular inner member disposed within the outer member. The inner tubular member is made of a fabric material that is formed in part with a relatively closed mesh construction and in part with a relatively open mesh construction so that the inner member emits air over a predetermined arcuate flow path through the open mesh part. The inner member directs the predetermined arcuate flow path into the outer member so that part of the conditioned air diffuses directly through the outer member in the predetermined arcuate flow path, the predetermined arcuate flow path preferably being directed towards the spinning machine. The conditioned air is thus delivered to the spinning machine at localized areas and at a low velocity.

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**Hattori, U.S. Patent No. 5,164,012 ("Hattori")**

Hattori teaches a heat treatment apparatus having a reaction furnace including a reaction chamber for accommodating a plurality of objects, major surfaces of which are faced to each other at intervals, and a heater provided outside the reaction chamber, gas supply tube for introducing a gas into the reaction chamber therethrough, flow-directing unit for directing gas flow in a first direction substantially parallel to the surfaces of the objects, gas exhaust tube for exhausting a gas outside the reaction chamber, and moving unit for moving the gas flow in a second direction different from the first direction (col. 3, lines 5-28). Hattori further teaches a method of forming thin films on objects of heat treatment having the steps of causing a first gas flow introduced from a first gas supply tube and a second gas flow introduced from a second gas supply tube to meet each other, thereby producing a third gas flow flowing in a direction substantially parallel to the surfaces of the objects, major surfaces of which are faced to each other at intervals, disposed in a reaction chamber, and controlling flow rate of the first and second gas flows, thereby moving the position of the third gas flow in a second direction different from the first direction (col. 3, lines 29-40).

**Hwang, U.S. Patent No. 5,441,570 ("Hwang")**

Hwang discloses an apparatus for low pressure chemical vapor deposition (col. 3, line 55 to col. 4, line 14). Hwang's LPCVD apparatus has a compound source gas flow path which is formed between the inside and outside quartz tubes of the reactor. Within the path, the apparatus supplies the compound source gas from the upper section to the lower section of the reactor and permits source gas to be introduced into the deposition reacting space of the reactor while being mixed and heated.

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### ARGUMENTS ON APPEAL

**A. Claims 1-12 are Patentable over Hattori in View of Gengler.**

The rejection of claims 1-12 under 35 USC § 103(a) as being obvious over Hattori in view of Gengler is in error.

Hattori discloses a gas treatment apparatus with an inner tube 10 and a gas feeder 19 provided between the inner tube 10 and a wafer boat 15 (Figure 1). However, as the Examiner recognizes, Hattori does not teach a gas inlet port gradually reduced in cross section in a predetermined direction, as required by Appellant's claim 1. Figs. 1 and 3 of Hattori are shown below. Fig. 3 shows the cross-section of Hattori's gas inlet port, and, as shown in Fig. 1, the cross-section of Hattori is constant.

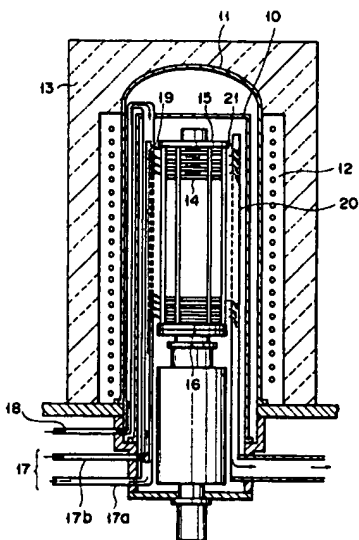


FIG. 1

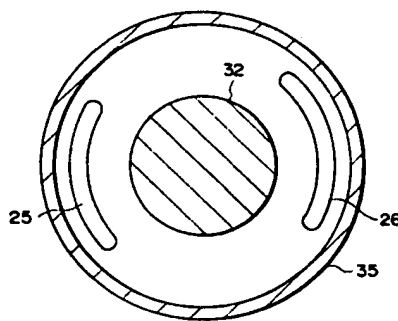


FIG. 3

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Moreover, Hattori's gas flow handling apparatus is quite different from Appellant's claimed invention. Hattori's solution to the gas flow problem above discussed is to introduce a first gas flow from a first gas supply in one direction, and a second gas flow from a second gas supply in a second direction to produce a third gas flow flowing in a direction substantially parallel to the surfaces of the objects being treated (col. 3, lines 29-40). Indeed, the basic contribution to the art of Hattori is to provide a reaction furnace having two gas supply means introducing gas flow from two different directions.

In rejecting the claims as obvious from Hattori in view of Gengler, the Examiner acknowledges Hattori fails to teach a gas passage gradually reduced in area in which the gas feeder has a narrow end surface and a wide end surface (Final Action, ¶ 8). However, the Examiner takes the position that this missing teaching is applied by Gengler, and that it would be obvious to one skilled in the art to modify Hattori by the teachings of Gengler.

Clearly, there would be no motivation to make these modifications proposed by the Examiner. Hattori's contribution to the art is in his gas supply means in which two gas flows in opposite directions are supplied to meet to form a third gas flow. That is what Hattori teaches. The Examiner's proposed modification of Hattori ignores the basic teachings of Hattori and is clearly based on hindsight.

Gengler is an open system for textile manufacturing. While Gengler may teach a tapered inner tubular member (Fig. 2), the tube described in Gengler would be functionally inappropriate if used in a gas treatment apparatus as required by Appellant's claim 1. The apparatus of claim 1 requires a wafer boat, and a gas feeder between an inner tube and a wafer boat connected to a gas inlet port for blowing gas to the wafers. The gas feeder described in Gengler cannot

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accommodate a wafer boat at the upper portions of the tapered inner tubular member, and specifically is contraindicated in Appellant's specification (col. 11, line 20 to col. 12, line 11), in which it is described how it would be impossible to place a cone-shaped or pyramidal gas feeder inside the inner tube 3 because most of the inner space is occupied by the wafer boat 5.

Furthermore, Gengler teaches an inner member 24' with a tapered mesh structure. Gas feeders, which are used in the diffusion furnaces, are well known to persons in the art, and are made of quartz. The manufacturer periodically cleans the gas feeders to prevent clogging. In this situation, it is impossible to make an inner member with a tapered mesh structure of quartz. Even if a quartz tapered mesh inner member is manufactured, it is impossible to clean the quartz tapered mesh inner member to prevent clogging without damage to the inner member. Thus, persons skilled in the art never use a quartz tapered mesh inner member in a diffusion furnace.

Moreover, if a tapered mesh inner member were to be used in a diffusion furnace, as suggested by the Examiner, the distance between the tapered mesh inner member and the target members to which the gas is fed is varied with the distance from the gas inlet end of the tapered mesh inner member due to the "tapered" structure. This means that the gas pressure around the target members would be further dependent on the distance between the tapered mesh inner member and the target members, and the pressure is less controllable.

In Appellant's claimed invention, the distance between the wafer boat and the gas feeder is constant. The gas feeder does not have a wall on the closer side of the feeder to the wafer boat, and the gas pressure is not dependent on the distance from the gas inlet port and the wafers. This means that the gas feeder makes the gas pressure around the wafers constant.

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Quite apart from the foregoing, Gengler is not even analogous art, as the Gengler reference is directed to a diffuser used in the textile industry for distributing conditioned air to air jet or open end spinning machines in order to reduce the moisture deficit zone created by compressed air in spinning machines and the present invention relates to the manufacture of semiconductors.

As this Board knows, "two criteria have evolved for determining whether prior art is analogous: (1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of the inventor's endeavor, whether the reference is still reasonably pertinent to the particular problem with which the inventor is involved." *In re Clay*, 966 F.2d 656, 23 USPQ2d 1058 (Fed. Cir. 1992).

A reference may be "reasonably pertinent," even if it is in a different field of endeavor if "it is one which, because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering his problem." *Id.* A person having ordinary skill in the art would not have considered references dealing with textile diffusers using ambient air, which as noted at column 3, lines 50-58, contains lint and similar foreign material, in an attempt to solve problems relating to semiconductor manufacturing. Accordingly, Appellant respectfully submits that Gengler is non-analogous art and is not properly combinable with Hattori to form a legally sufficient rejection under 35 U.S.C. §103(a). Thus, claim 1 and the several claims dependent thereon cannot be said to be obvious from Hattori in view of Gengler.

**B. Claims 13-19 are Patentable over Hattori and Gengler in View of Hwang.**

Turning to the rejection of claims 13-19 under 35 USC § 103(a) as being unpatentable over Hattori and Gengler as applied to claims 1-12 above and further in view of Hwang, these

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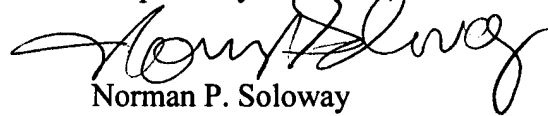
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claims are likewise patentable over Hattori and Gengler for the reasons discussed above, as well as for their own limitations. Claim 13 is similar to claim 1 in requiring a retainer for wafers in the inner space of the apparatus, and a tapered gas feeder connected to a gas inlet port. The deficiencies of Hattori and Gengler vis-à-vis this claim combination are discussed above. Hwang has been cited as teaching an inlet hole at one end of a gas inlet port 11 (Figures 1-3). Hwang does not teach a gas feeder, much less one with a gas passage reducing cross-sections from one end to another end with a plurality of gas outlet holes, as required by Appellant's claim 13. Thus, no combination of Hattori, Gengler and Hwang reasonably could be said to achieve or render obvious claim 13, nor any of the claims dependent therefrom.

### CONCLUSION

In view of the foregoing, it is respectfully submitted that the Examiner's Final Rejection of the subject Application is in error, and it is requested that the Rejection be reversed in all respects.

Respectfully submitted,



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**APPENDIX A**



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APPENDIX A

1. A gas treatment apparatus comprising:

an outer tube having a gas inlet port connected to a gas supply system for receiving gas and a gas outlet port connected to an exhaust pipe, and defining an inner space;

a wafer boat provided in said inner space and holding plural wafers spaced from one another in a predetermined direction;

an inner tube provided between said wafer boat and said outer tube and elongated in said predetermined direction; and

a gas feeder provided between said inner tube and said wafer boat, connected to a said gas inlet port and defining a gas passage gradually reduced in cross section in said predetermined direction, and formed with a plurality of like gas outlet holes equal in open area and equally spaced in said predetermined direction for blowing said gas to said wafers.

2. The gas treatment apparatus as set forth in claim 1, in which said gas feeder has a narrow end surface, a wide end surface, a convex outer surface extending between said narrow end surface and said wide end surface, a concave inner surface extending between said narrow end surface and said wide end surface and spaced from said convex outer surface and semi-cylindrical side surfaces connected between one of the side lines of said convex outer surface and one of the side lines of said concave inner surface and between the other of said side lines of said convex outer surface and the other of said side lines of said concave inner surface, and said gas inlet port is connected to said gas feeder at a position closer to said wide end surface than said narrow end surface.

3. The gas treatment apparatus as set forth in claim 2, in which said gas outlet holes are formed in said inner concave surface on a virtual line extending from said wide end surface toward said narrow end surface.
4. The gas treatment apparatus as set forth in claim 2, in which said outer convex surface and said inner concave surface are opposed to the inner surface of said outer tube and said wafer boat, respectively, and said gas outlet holes are formed in said inner concave surface.
5. The gas treatment apparatus as set forth in claim 3, in which said virtual line is a generating line of said concave inner surface, and is substantially in parallel to a centerline of said wafer boat.
6. The gas treatment apparatus as set forth in claim 2, in which said wide end surface has a generally crescent shape.
7. The gas treatment apparatus as set forth in claim 1, in which said gas passage and said gas outlet holes keeps the pressure of said gas inside of said gas feeder substantially constant.
8. The gas treatment apparatus as set forth in claim 1, in which said gas contains a doping gas component, and said doping gas component is supplied through said gas feeder to said wafers supported in said wafer boat.
9. The gas treatment apparatus as set forth in claim 8, said gas further contains a reactant gas component used for depositing a material on said wafers.
10. The gas treatment apparatus as set forth in claim 1, in which said outer tube serves as an outer shell of a reactor forming a part of a chemical vapor deposition system.